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(54) **INK JET PRINTER WITH APPARATUS FOR CURING INK AND METHOD**

TINTENSTRAHLDRUCKER MIT VORRICHTUNG ZUM TROCKNEN DER TINTE UND DESSEN BETRIEBSVERFAHREN

IMPRIMANTE A JET D'ENCRE COMPORTANT UN APPAREIL DE SECHAGE DE L'ENCRE ET PROCEDE S'Y RAPPORTANT

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- **PATENT ABSTRACTS OF JAPAN vol. 015, no. 505 (M-1194), 20 December 1991 & JP,A,03 222748 (NIPPON PAINT CO LTD), 1 October 1991,**

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Description

[0001] This invention is concerned with improvements in and relating to printing apparatus and processes, more especially ink jet printing processes and, particularly, such processes employing radiation-curable inks such as UV-curable inks.

[0002] Ink jet printing processes are well known and well established (see, for example, "Output Hardcopy Devices", Durbeck R.C. and Sherr S., Eds. Academic Press Inc., 1908, at pages 311-370). The use of radiation-curable, especially UV-curable, inks in such a process would appear highly desirable since, after appropriate curing, radiation curable inks afford a tough, durable image upon the substrate to which they are applied. This makes the process especially applicable to printing on plastics packaging where high durability is required. Therefore, it can be applied not only to conventional cellulosic substrates such as paper and board, but also to synthetic polymeric substrates.

[0003] We have found that problems can be encountered in printing a radiation-curable ink upon a substrate by an ink jet printing process and subsequently curing the substrate, bearing the uncured printed image, by exposing it to radiation in a conventional manner. Thus in accordance with usual procedures, substrates bearing uncured radiation-curable images are cured by passing them under one or more radiation sources (e.g. mercury vapour lamps in the case of UV-radiation) at a relatively high linear speed. Since ink jet printing is relatively slow, as compared with some other printing methods, the first printed portion of a substrate may well bear an uncured image for a markedly longer period of time than the last printed portion of that substrate, before curing of the printed image. We have found that this can give rise to problems and undesirable results due, for example, to differential absorption of the ink into a porous substrate, such as a cellulosic web, or spreading or mixing of colours before curing.

[0004] EP-A-284 215 discloses a thermal ink jet printer in which a scanning print head traverses a substrate which moves step-wise through a drying zone.

[0005] In accordance with a first aspect of the present invention, there is provided a process as defined in claim 1.

[0006] In accordance with a second aspect of the present invention, there is provided, an ink jet printing apparatus as defined in claim 12.

[0007] The process and apparatus of the present invention are particularly suitable for use in combination with a drop on demand process but, of course, may also be used in combination with other ink jet printing processes, either continuous or intermittent. In the following description, reference will be made only to UV-curable inks but it is to be understood that, where the context permits, reference to other forms of radiation-curable inks is intended.

[0008] With presently available UV sources, it is difficult to provide a small enough radiation source connected to and travelling with the print head. In accordance with a particular embodiment of the present invention, a static fixed radiation source is employed and the curing UV radiation is supplied from that source to an irradiation head, of appropriate dimensions, connected with the radiation source by means of flexible radiation conductive means such as fibre as a fibre optic bundle or an internally reflective flexible tube.

[0009] Alternatively, UV curing radiation may be supplied from a fixed source to the radiation head by an arrangement of mirrors including a mirror upon the radiation head. If desired, unwanted forms of radiation, e.g. visible or infra-red radiation, may be wholly or partially filtered out from the curing UV radiation and this has the advantage of reducing the amount of unwanted energy supplied to the substrate, thereby avoiding problems such as softening of plastic substrates or enbrittlement of cellulosic substrates.

[0010] In a practical arrangement, it may be desirable to provide a plurality of print heads in relative close proximity in a printing station, for printing with different coloured inks to produce a multi-coloured image. In that case, each has its own dedicated radiation source.

[0011] Further advantages may be obtained if the or each curing means is arranged such that the radiation is emitted at a variable distance downstream of the or each respective print head. This adjustment can allow the printed ink droplets to effect a desired degree of spreading/fusion to enhance image quality.

[0012] It is also possible to place a second radiation source at a further distance away from the print head or print station. In this way, the two beams of radiation striking the substrate can be arranged to have different intensities, for example the beam(s) striking the substrate nearest to the print head(s) could have a relatively low intensity and the second, further away, beam could have a higher intensity. This has the further advantage that some pre-curing of the printed droplets may be affected by the first beam to provide further control of the amount of spreading/fusion and viscosity of the printed droplets, prior to final curing by the second beam.

[0013] UV-curable printing inks are well known and do not form a part of the present invention. For example, our UK patent application no. 9603667.8, unpublished at the priority date of the present invention, discloses a UV-curable ink jet composition comprising an alkoxylated or polyalkoxylated acrylate monomer, a photoinitiator and a colourant. In any event, UV-curable printing inks generally comprise an ethylenically unsaturated monomer or oligomeric binder which polymerises, under the influence of UV-radiation, to form a cured resinous binder. Generally such inks also contain UV photo initiators serving to initiate polymerisation of the monomer or oligomer on exposure to UV radiation.

[0014] The principle underlying the present invention, namely arranging ink jet printing means and curing means so that the time period between printing and cur-

ing for any portion of the substrate is substantially the same, may also be applied to other curing systems such as drying or cooling systems.

[0015] The present invention will now be explained in more detail by way of the following description of non-limiting embodiments and with reference to the accompanying drawings in which:-

Figure 1 shows an apparatus and process according to a first embodiment of the present invention;
Figure 2 shows an apparatus and process according to a second embodiment of the present invention;
Figure 3 shows a modification of the second embodiment of the present invention, with a variable-position radiation emitting head; and
Figure 4 shows another variant of the second embodiment of the present invention, having two mutually separated radiation-emitting heads.

[0016] Turning now to Figure 1, there is shown a substrate 1 moving in the direction of a single-headed arrow 3. A print head 5 arranged for printing with a UV-curable ink traverses the substrate 1 as shown by the double headed arrow 7, in a direction perpendicular to the single-headed arrow 3. A first mirror 9 is fixed to the print head 5. A second mirror 11 is arranged to one side of the substrate, as is a laser 13.

[0017] In use, a radiation beam 15 from the laser 13 is reflected via the second mirror 11 and then the first mirror 9 to impinge upon the substrate at a position 17 which is at a fixed distance downstream (i.e. in the direction of travel of the substrate 1 as denoted by the single-headed arrow 3). This fixed position is maintained because the first mirror 9 is attached to the print head 5. The positions of the second mirror 11 and laser 13 are also such that the radiation beam will strike the substrate at this fixed distance downstream of the print head 5.

[0018] Turning now to Figure 2, instead of the first mirror 9 shown in the embodiment of Figure 1, a radiation-emitting head 19 is attached to the print head 5. This head 19 is connected via a flexible light-pipe or optical fibre 21 to an external radiation source 23. In use, as the print head 5 traverses the width of the substrate as denoted by the doubleheaded arrow 7, the radiation emitted by the emission head 19 will always be at a fixed point down stream of the print head in the direction of travel of the substrate.

[0019] Turning now to Figure 3, there is shown a variant of the second embodiment shown in Figure 2, as seen from one side. Here, the substrate travels in a direction shown by the solid single-headed arrow 29. Attached to the print head 5 is a runner 31 extending downstream of the print head 5. The radiation-emitting head 19 is mounted on this runner so that it can be located in a predetermined chosen position downstream of the head 5, to allow a predetermined air-drying/spreading time for the ink 33 after it is deposited on the substrate.

[0020] A further embellishment of the arrangement shown in Figure 3 is shown in Figure 4. Again, the substrate 1 travels in a direction shown by the solid single-headed arrow 29. As well as the print head 5 with downstream-extending runner 31 with radiation-emitting head 19 mounted thereon, there are shown a second print head 35 and a third print head 37 respectively positioned downstream of the first print head 5. These additional print heads show a more usual situation where a plurality of heads is provided to print in respective different colours. Of course, such an arrangement could be used in the situation shown in Figure 3 but are omitted there for clarity.

[0021] The additional print heads 35, 37 also have respective downstream-extending runners 39, 41, each of the latter supporting a respective additional radiation-emitting head 43, 45.

[0022] Just as the first print head 5 applies respective ink droplets 33 onto the substrate 1, the second and third heads 35, 37 print respective ink droplets 47, 49 at downstream positions on the substrate 1. The positions of the radiation sources 19, 43, 45 are each individually variable along their respective runners 31, 39, 41, relative to their associated respective print head 5, 35, 37.

[0023] At a greater distance downstream of the print heads 5, 35, 37 is situated another radiation source 51 extending across the substrate 1. This additional radiation source 51 is adapted to irradiate the image on the substrate 1 with a significantly higher intensity of radiation than the print head specific radiation sources 19, 43, 45.

[0024] In use, the embodiment shown in Figure 4 allows low-intensity radiation beam to perform pre-curing of the printed droplets 33, 47, 49 at respective first positions downstream of their print heads 5, 35, 37 to semi-harden/fix the droplets, thus controlling droplet spread and merging. Then a second higher dose of radiation is emitted from the last radiation-emitting head 51 further downstream, to provide complete curing of the printed image.

[0025] In the light of this disclosure, modifications of the described embodiment, as well as other embodiments, all within the scope of the present invention as defined by the appended claims will now become apparent to persons skilled in this art.

Claims

1. A process for forming an image upon a moving substrate (1), the process comprising the steps of ink jet printing a radiation-curable ink (33,47,49) onto the substrate (1) with a print head (5) and subsequently curing the printed image by exposure to appropriate radiation, characterised in that first curing means (9,19) is provided to direct radiation (15) at the substrate (1) from a first position at a predeter-

mined distance from the print head (5) in the direction of movement (3,29) of the substrate (1), the first curing means (9,19) being arranged in combination with the print head (5) for travelling therewith, so that the time period between printing and curing is substantially the same for all portions of the substrate (1).

2. A process according to claim 1, wherein the first curing means (9,19) is adjustable so that the predetermined distance may be varied.

3. A process according to claim 1 or claim 2, wherein second curing means (51) is provided to direct further radiation at the substrate (1) from a second position at a different predetermined distance from the print head (5) in the direction of movement of the substrate (1).

4. A process according to claim 3, wherein the second curing means (51) provides a higher intensity of radiation to impinge upon the image than that produced by the first curing means (5).

5. A process according to claim 4, wherein one or more further print heads (35, 37) are provided, each with a respective dedicated curing means (43,45) at a predetermined distance therefrom, for enabling printing with a plurality of inks (33,47,49) of different colours and each of the dedicated curing means (43,45) provides a lower intensity of radiation (15) than the second curing means (51).

6. A process according to any preceding claim, wherein the first curing means comprises an irradiation head (19) connected to a radiation source (23) by means of flexible radiation conductive means (21).

7. A process according to any of claims 1-5, wherein the first curing means comprises a mirror (9) attached to the print head for directing the radiation (15) onto the substrate, a radiation source (13) being provided in a fixed position so as to transmit radiation to the mirror (9).

8. A process according to claim 7, wherein the first curing means communicates with at least one further mirror (11) for defining an optical path between the radiation source (13) and the mirror (9) attached to the print head (5).

9. A process according to claim 7 or claim 8, wherein the radiation source (13, 23) comprises a laser.

10. A process according to claim 3 or claim 4, wherein the second curing means (51) has the same form as the first curing means (19).

11. A process according to any preceding claim, wherein the radiation-curable ink (33, 47, 49) is a UV-curable ink.

12. An ink jet printing apparatus for printing onto a substrate (1) with a radiation-curable ink, the apparatus comprising a print head (5) for directing the ink (33,47,49) onto the substrate (1) and curing means for curing a printed image by exposure to appropriate radiation characterised in that the curing means comprises first curing means (9,19) for directing radiation (15) at the substrate (1) from a first position at a predetermined distance from the print head (5) in the direction of movement (3,29) of the substrate (1), the first curing means being arranged in combination with the print head (5) for travelling therewith, so that the time period between printing and curing it substantially the same for all portions of the substrate (1).

13. An apparatus according to claim 12, wherein the first curing means (9,19) is adjustable so that the predetermined distance may be varied.

14. An apparatus according to claim 12 or claim 13, further comprising second curing means (51) for directing further radiation at the substrate (1) from a second position at a different predetermined distance from the print head (5) in the direction of movement of the substrate (1).

15. An apparatus according to claim 14, wherein the second curing means (51) is adapted to provide a higher intensity of radiation to impinge upon the image than that produced by the first curing means (5).

16. An apparatus according to claim 15, further comprising one or more further print heads (35, 37), each with a respective dedicated curing means (43,45) at a predetermined distance therefrom for enabling printing with a plurality of inks (33,47,49) of different colours wherein each of the dedicated curing means (43, 45) is adapted to provide a lower intensity of radiation (15) than the second curing means (51)

17. An apparatus according to any of claims 12 to 16, wherein the first curing means comprises a radiation head (19) connected to a radiation (23) source by means of flexible radiation conductive means (21).

18. An apparatus according to any of claims 12 to 16, wherein the first curing means comprises a mirror (9) attached to the print head for directing the radiation (15) onto the substrate, a radiation source (13) being provided in a fixed position so as to transmit radiation to the mirror (9).

19. An apparatus according to claim 18, wherein the first curing means comnunicate with at least one further mirror (11) for defining an optical path between the radiation source (13) and the mirror (9) attached to the print head (5).

20. An apparatus according to claim 18 or claim 19 wherein the radiation source (13,23) comprises a laser.

21. An apparatus according to claim 14 or claim 15, wherein the second curing means (51) has the same form as the first curing means (19).

22. An apparatus according to any preceding claim, further comprising a supply of UV-curable ink (33,47,49).

Patentansprüche

1. Verfahren zur Schaffung eines Bildes auf einem sich bewegenden Substrat (1), wobei das Verfahren die Schritte des Tintenstrahldruckens einer durch Strahlung härtbaren Tinte (33, 47, 39) auf das Substrat (1) mit einem Druckkopf (5) und des anschließenden Härtens des gedruckten Bildes durch die Einwirkung von geeigneter Strahlung umfaßt, dadurch gekennzeichnet, daß erste Härtungsmittel (9, 19) bereitgestellt werden, um eine Strahlung (15) von einer ersten Position in einem im voraus bestimmten Abstand vom Druckkopf (5) in der Bewegungsrichtung (3, 29) des Substrats (1) auf das Substrat (1) zu richten, wobei die ersten Härtungsmittel (9, 19) in Kombination mit dem Druckkopf (5) angeordnet sind, um sich mit diesem zu bewegen, so daß die Zeitspanne zwischen dem Drucken und dem Härten im wesentlichen für alle Abschnitte des Substrats (1) die gleiche ist.

2. Verfahren nach Anspruch 1, worin die ersten Härtungsmittel (9, 19) verstellbar sind, so daß der im voraus bestimmte Abstand variiert werden kann.

3. Verfahren nach Anspruch 1 oder Anspruch 2, worin zweite Härtungsmittel (51) bereitgestellt werden, um weitere Strahlung von einer zweiten Position in einem unterschiedlichen, im voraus bestimmten Abstand vom Druckkopf (5) in der Bewegungsrichtung des Substrats (1) auf das Substrat (1) zu richten.

4. Verfahren nach Anspruch 3, worin die zweiten Härtungsmittel (51) eine höhere Strahlungsintensität für das Aufprallen auf das Bild als diejenige bereitstellen, die durch die ersten Härtungsmittel (5) erzeugt wird.

5. Verfahren nach Anspruch 4, worin ein oder mehrere weitere Druckköpfe (35, 37) bereitgestellt werden, jeder mit einem entsprechenden, zugeordneten Härtungsmittel (43, 45) in einem im voraus bestimmten Abstand zu diesem, um das Drucken mit einer Vielzahl von Tinten (33, 47, 49) von unterschiedlichen Farben zu ermöglichen, und jedes der zugeordneten Härtungsmittel (43, 45) eine niedrigere Intensität der Strahlung (15) als die zweiten Härtungsmittel (51) bereitstellt.

6. Verfahren nach einem der vorhergehenden Ansprüche, worin die ersten Härtungsmittel einen Bestrahlungskopf (19) umfassen, der durch flexible, strahlungsleitende Mittel (21) mit einer Strahlungsquelle (23) verbunden ist.

7. Verfahren nach einem der Ansprüche 1 bis 5, worin die ersten Härtungsmittel einen Spiegel (9) umfassen, der am Druckkopf befestigt ist, um die Strahlung (15) auf das Substrat zu richten, wobei eine Strahlungsquelle (13) in einer feststehenden Position bereitgestellt wird, um die Strahlung auf den Spiegel (9) zu übertragen.

8. Verfahren nach Anspruch 7, worin die ersten Härtungsmittel mit wenigstens einem weiteren Spiegel (11) in Verbindung stehen, um eine optische Bahn zwischen der Strahlungsquelle (13) und dem am Druckkopf (5) angebrachten Spiegel (9) zu definieren.

9. Verfahren nach Anspruch 7 oder Anspruch 8, worin die Strahlungsquelle (13, 23) einen Laser umfaßt.

10. Verfahren nach Anspruch 3 oder Anspruch 4, worin die zweiten Härtungsmittel (51) dieselbe Form wie die ersten Härtungsmittel (19) haben.

11. Verfahren nach einem der vorhergehenden Ansprüche, worin die durch Strahlung härtbare Tinte (33, 47, 49) eine UV-härtbare Tinte ist.

12. Tintenstrahldruckvorrichtung zum Drucken mit einer durch Strahlung härtbaren Tinte auf einem Substrat (1), wobei die Vorrichtung einen Druckkopf (5), um die Tinte (33, 47, 49) auf das Substrat (1) zu richten, und Härtungsmittel umfaßt, um ein gedrucktes Bild durch Einwirkung einer geeigneten Strahlung zu härten, dadurch gekennzeichnet, daß die Härtungsmittel erste Härtungsmittel (9, 19) umfassen, um die Strahlung (15) von einer ersten Position in einem im voraus bestimmten Abstand vom Druckkopf (15) in der Bewegungsrichtung (3, 29) des Substrats (1) auf das Substrat (1) zu richten, wobei die ersten Härtungsmittel in Kombination mit dem Druckkopf (5) angeordnet sind, um sich mit diesem zu bewegen, so daß die Zeitspanne zwi-

schen dem Drucken und dem Härten im wesentlichen für alle Abschnitte des Substrats (1) die gleiche ist.

13. Vorrichtung nach Anspruch 12, worin die ersten Härtungsmittel (9, 19) verstellbar sind, so daß der im voraus bestimmte Abstand variiert werden kann.

14. Vorrichtung nach Anspruch 12 oder Anspruch 13, die außerdem zweite Härtungsmittel (51) umfaßt, um weitere Strahlung von einer zweiten Position in einem unterschiedlichen, im voraus bestimmten Abstand vom Druckkopf (5) in der Bewegungsrichtung des Substrats (1) auf das Substrat (1) zu richten.

15. Vorrichtung nach Anspruch 14, worin die zweiten Härtungsmittel (51) dafür geeignet sind, eine höhere Strahlungsintensität für das Aufprallen auf das Bild als diejenige bereitstellen, die durch die ersten Härtungsmittel (5) erzeugt wird.

16. Vorrichtung nach Anspruch 15, die außerdem einen oder mehrere weitere Druckköpfe (35, 37) umfaßt, jeder mit einem entsprechenden, zugeordneten Härtungsmittel (43, 45) in einem im voraus bestimmten Abstand zu diesem, um das Drucken mit einer Vielzahl von Tinten (33, 47, 49) von unterschiedlichen Farben zu ermöglichen, worin jedes der zugeordneten Härtungsmittel (43, 45) dafür geeignet ist, eine niedrigere Intensität der Strahlung (15) als die zweiten Härtungsmittel (51) bereitzustellen.

17. Vorrichtung nach einem der Ansprüche 12 bis 16, worin die ersten Härtungsmittel einen Bestrahlungskopf (19) umfassen, der durch flexible, strahlungsleitende Mittel (21) mit einer Strahlungsquelle (23) verbunden ist.

18. Vorrichtung nach einem der Ansprüche 12 bis 16, worin die ersten Härtungsmittel einen Spiegel (9) umfassen, der am Druckkopf befestigt ist, um die Strahlung (15) auf das Substrat zu richten, wobei eine Strahlungsquelle (13) in einer feststehenden Position bereitgestellt wird, um die Strahlung auf den Spiegel (9) zu übertragen.

19. Vorrichtung nach Anspruch 18, worin die ersten Härtungsmittel mit wenigstens einem weiteren Spiegel (11) in Verbindung stehen, um eine optische Bahn zwischen der Strahlungsquelle (13) und dem am Druckkopf (5) angebrachten Spiegel (9) zu definieren.

20. Vorrichtung nach Anspruch 18 oder Anspruch 19, worin die Strahlungsquelle (13, 23) einen Laser umfaßt.

21. Vorrichtung nach Anspruch 14 oder Anspruch 15, worin die zweiten Härtungsmittel (51) dieselbe Form wie die ersten Härtungsmittel (19) haben.

22. Vorrichtung nach einem der vorhergehenden Ansprüche, die außerdem eine Zuführung für UV-härtbare Tinte (33, 47, 49) umfaßt.

Revendications

1. Procédé de formation d'une image sur un substrat mobile (1), le procédé comprenant les étapes d'impression à jet d'encre d'une encre à séchage (durcissement) par rayonnement (33, 47, 49) sur le substrat (1), avec une tête d'impression (5), et de séchage ultérieur de l'image imprimée par exposition à un rayonnement approprié, caractérisé en ce qu'un premier moyen de séchage (9, 19) est destiné à diriger le rayonnement (15) sur le substrat (1) à partir d'une première position, à une distance prédéterminée de la tête d'impression (5), dans la direction du déplacement (3, 29) du substrat (1), le premier moyen de séchage (9, 19) étant agencé en combinaison avec la tête d'impression (5) de sorte à se déplacer avec celle-ci, la période de temps entre l'impression et le séchage étant ainsi pratiquement identique pour toutes les parties du substrat (1).

2. Procédé selon la revendication 1, dans lequel le premier moyen de séchage (9, 19) est ajustable, de sorte que la distance prédéterminée peut être variée.

3. Procédé selon les revendications 1 ou 2, dans lequel un deuxième moyen de séchage (51) est destiné à diriger un rayonnement additionnel sur le substrat (1) à partir d'une deuxième position, à une distance prédéterminée différente de la tête d'impression (5), dans la direction du déplacement du substrat (1).

4. Procédé selon la revendication 3, dans lequel le deuxième moyen de séchage (51) entraîne le heurt d'un rayonnement d'intensité accrue sur l'image que celui produit par le premier moyen de séchage (5).

5. Procédé selon la revendication 4, comportant une ou plusieurs têtes d'impression additionnelles (35, 37), chacune comportant un moyen de séchage spécifique respectif (43, 45), agencé à une distance prédéterminée, pour permettre l'impression avec plusieurs encres (33, 47, 49) de couleur différente, chacun des moyens de séchage spécifiques (43, 45) entraînant un rayonnement d'intensité inférieure (15) à celui du deuxième moyen de séchage (51).

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel le premier moyen de séchage comprend une tête d'irradiation (19), connectée à une source de rayonnement (23) par l'intermédiaire d'un moyen conducteur flexible du rayonnement (21).

7. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel le premier moyen de séchage comprend un miroir (9), fixé à la tête d'impression pour diriger le rayonnement (15) sur le substrat, une source de rayonnement (13) étant agencée dans une position fixe, de sorte à transmettre le rayonnement vers le miroir (9).

8. Procédé selon la revendication 7, dans lequel le premier moyen de séchage communique avec au moins un miroir additionnel (11) pour définir une trajectoire optique entre la source de rayonnement (13) et le miroir (9) fixé à la tête d'impression (5).

9. Procédé selon les revendications 7 ou 8, dans lequel la source de rayonnement (13, 23) comprend un laser.

10. Procédé selon les revendications 3 ou 4, dans lequel le deuxième moyen de séchage (51) a la même forme que le premier moyen de séchage (19).

11. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'encre à séchage par rayonnement (33, 47, 49) est une encre à séchage aux UV.

12. Dispositif d'impression à jet d'encre destinée à imprimer sur un substrat (1) avec une encre à séchage par rayonnement, le dispositif comprenant une tête d'impression (5), destinée à diriger l'encre (33, 47, 49) sur le substrat (1), et un moyen de séchage, pour sécher une image imprimée par exposition à un rayonnement approprié, caractérisée en ce que le moyen de séchage comprend un premier moyen de séchage (9, 19) pour diriger le rayonnement (15) sur le substrat (1) à partir d'une première position, agencée à une distance prédéterminée de la tête d'impression (5), dans la direction du déplacement (3, 29) du substrat (1), le premier moyen de séchage étant agencé en combinaison avec la tête d'impression (5) de sorte à se déplacer avec celle-ci, la période de temps entre l'impression et le séchage étant ainsi pratiquement identique pour toutes les parties du substrat (1).

13. Dispositif selon la revendication 12, dans lequel le premier moyen de séchage (9, 19) est ajustable, de sorte que la distance prédéterminée peut être variée.

14. Dispositif selon les revendications 12 ou 13, comprenant en outre un deuxième moyen de séchage (51), destiné à diriger un rayonnement additionnel sur le substrat (1) à partir d'une deuxième position, à une distance prédéterminée différente de la tête d'impression (5), dans la direction du déplacement du substrat (1).

15. Dispositif selon la revendication 14, dans lequel le deuxième moyen de séchage (51) entraîne le heurt d'un rayonnement d'intensité accrue sur l'image que celui produit par le premier moyen de séchage (5).

16. Dispositif selon la revendication 15, comportant une ou plusieurs têtes d'impression additionnelles (35, 37), chacune comportant un moyen de séchage spécifique respectif (43, 45), agencé à une distance prédéterminée, pour permettre l'impression avec plusieurs encres (33, 47, 49) de couleur différente, chacun des moyens de séchage spécifiques (43, 45) entraînant un rayonnement d'intensité inférieure (15) à celui du deuxième moyen de séchage (51).

17. Dispositif selon l'une quelconque des revendications 12 à 16, dans lequel le premier moyen de séchage comprend une tête d'irradiation (19), connectée à une source de rayonnement (23) par l'intermédiaire d'un moyen conducteur flexible du rayonnement (21).

18. Dispositif selon l'une quelconque des revendications 12 à 16, dans lequel le premier moyen de séchage comprend un miroir (9), fixé à la tête d'impression pour diriger le rayonnement (15) sur le substrat, une source de rayonnement (13) étant agencée dans une position fixe, de sorte à transmettre le rayonnement vers le miroir (9).

19. Dispositif selon la revendication 18, dans lequel le premier moyen de séchage communique avec au moins un miroir additionnel (11) pour définir une trajectoire optique entre la source de rayonnement (13) et le miroir (9) fixé à la tête d'impression (5).

20. Dispositif selon les revendications 18 ou 19, dans lequel la source de rayonnement (13, 23) comprend un laser.

21. Dispositif selon les revendications 14 ou 15, dans lequel le deuxième moyen de séchage (51) a la même forme que le premier moyen de séchage (19).

22. Dispositif selon l'une quelconque des revendications précédentes, comprenant en outre une alimentation en encre à séchage aux UV (33, 47, 49).

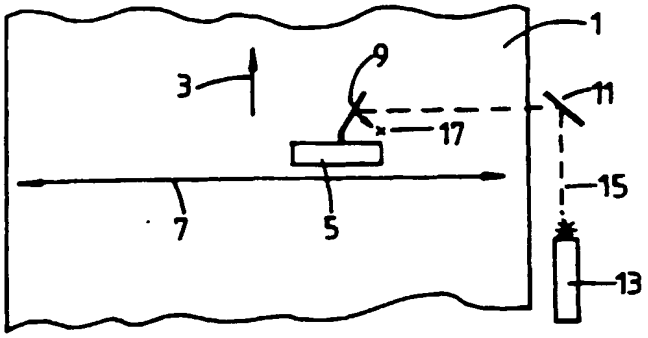

FIG .1

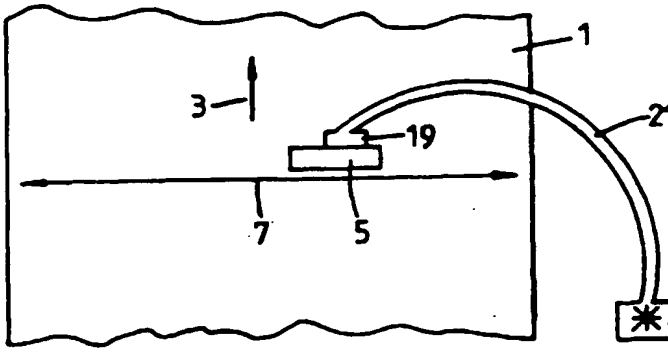

FIG . 2

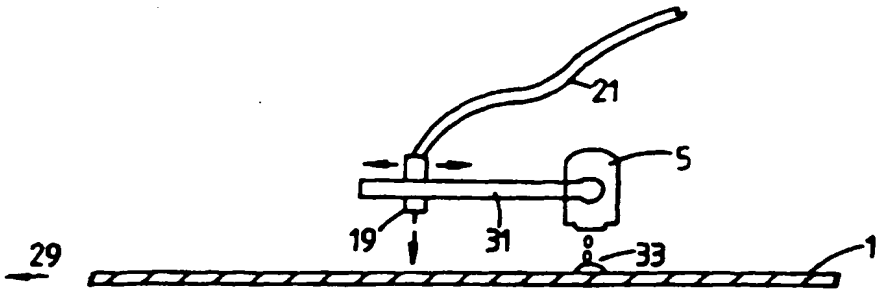

FIG. 3

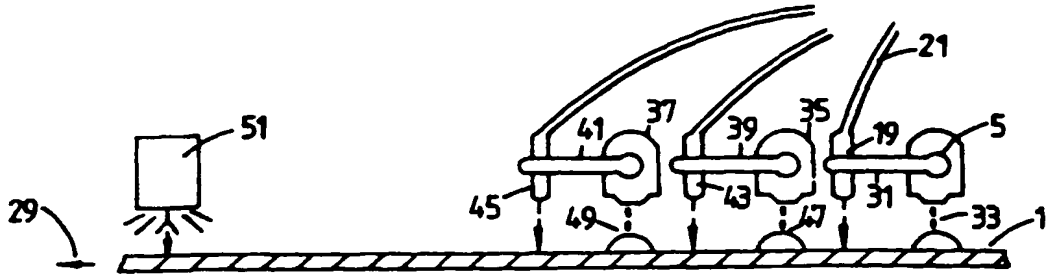

FIG. 4